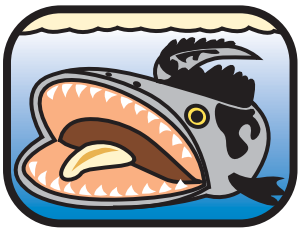

Lessons from the Bay

Native vs. Non-native Species: Who Will Win?

How do non-native animal and plant species cause problems in our schoolyard and in the Chesapeake Bay?

Objectives

Students will

- distinguish native species from non-native species
- research non-native species that have caused problems in water and land habitats of the Chesapeake Bay, and classify them by habitat and by Kingdom
- create "Most Wanted" posters describing invasive, non-native Bay species and the "crimes" for which they are "wanted"
- evaluate the role played by humans in the introduction of non-native species, and the subsequent attempts to control or eliminate them
- predict the percent of non-native plants in the schoolyard, identify plants, and classify them as native or non-native
- determine the effects of non-native species on biodiversity in the schoolyard habitat, the wildlife in our area, our water resources, and the Chesapeake Bay.

Background

All geographic regions are home to certain organisms that evolved as part of the region's ecosystem. As part of the food web, they are in balance with one another through predator-prey relationships and through competition for resources such as food, water, light, and space. They are called the *native species* of the region.

When an organism is introduced to a region from a different geographic region, it is called a *non-native species*. Non-native species sometimes fit well into the existing ecosystem, but they often have negative impacts such as reducing the biodiversity of the region, causing economic losses, and wasting and polluting water resources. They sometimes prey heavily on certain native species, and, because the non-natives may not have any natural predators, they can quickly reduce the populations of the natives. Occasionally this is so severe that it can cause local extinction of the native species. Non-natives are harmful economically when they eat or cause disease in agricultural crops. Finally, non-native plants can cause indirect damage to our water resources because they are not adapted to the region and therefore require extra water, fertilizer, and pesticide. This wastes our

Related Standards of Learning

Science:
3.1.a; 3.1.b; 3.1.g; 3.1.j; 3.6.a; 3.6.b; 3.6.c; 3.10.b; 3.10.d; 4.1.a; 4.1.b; 4.5.b; 4.5.d; 4.5.f; 4.8.b; 5.1.e; 5.1.f; 5.5.b
Mathematics:
3.10; 4.4; 4.9
English:
3.1; 3.2; 3.3; 3.4; 3.6.a; 3.6.b; 3.6.c; 3.6.d; 3.6.e; 3.6.f; 3.7; 3.9; 3.10; 3.11; 4.1; 4.2; 4.3; 4.5; 4.6; 4.7; 4.8; 5.1; 5.4; 5.6; 5.7.a; 5.8; 5.9; 6.3; 6.5; 6.6; 6.7
History and Social Science:
3.10; VS.1.b; VS.1.d; VS.1.h; USI.1.e; USII.2.b; USII.8.b

Time Required

3 45-minute sessions

Materials

- *"Exotics in the Chesapeake: Understanding Species Invasions" Factsheets #1, #2, and #3 (see Resources)*
- *"The Growing Threat of Invasive Species" (see Resources)*
- *"Native Plants for Conservation, Restoration, and Landscaping" booklet for your region of Virginia (see Resources)*
- Botanica*, by R.G. Turner (see Resources)*
- *plant guides: wildflower, tree, gardening plants (see Resources)*
- *Internet access*
- *cookie sheet with gram stackers (or other masses used with a balance)*
- *poster-size paper and drawing materials*
- *calculators*
- *Non-native Plants in the Schoolyard lab sheet*
- *clipboards (optional)*

water resources and pollutes them through runoff of excess nutrients and toxic chemicals.

Non-native species may be introduced by animals: for example, the seed of a non-native plant may be deposited in the waste of a migratory bird. Non-native species may also be introduced by humans. Some are introduced intentionally, such as garden plants collected by plant enthusiasts. People may also unintentionally carry non-native species when travelling. As the amount of global travel and trade has increased, so has the rate of introduction of non-native species. The United States Geological Survey reported that there were at least 6,271 non-native species established in the United States in 1999 (Baskin).

Ironically, a popular control method is to bring in another non-native to exterminate the existing non-native. While this can be an effective strategy, often the new non-native species causes new problems. For example, to control the spread of hydrilla, an underwater plant native to Southeast Asia, the grass carp was introduced to the Chesapeake Bay. The grass carp too is native to Southeast Asia and is a natural predator of hydrilla; however, it also eats the underwater plants native to the Bay, causing a new problem. In an attempt to limit the destruction caused by the grass carp, authorities began using only triploid specimens (i.e., grass carp genetically altered to prevent reproduction). The hope was that the carp, with no offspring, would eventually die off in the Bay. This solution may prove to be ineffective, however, because other cases have illustrated that triploid organisms can revert to being diploid and therefore become capable of reproduction.

Procedures

Session 1 (45 minutes)

Conduct this session in the classroom.

1. Place a kilogram (equal to about two pounds) of gram stackers on each corner of the cookie sheet. Stack the masses so they are as close to the corners as possible. Stand the flashlight on end in the middle of a table, and carefully balance the cookie sheet on top of the flashlight. Explain to students that each corner represents one of four types of organisms in the habitat of our geographic region: *carnivores*, *herbivores*, *plants*, and *decomposers*. The carnivores eat a certain number of the herbivores, who eat a certain amount of the plants; in turn, when the animals die, they provide a certain amount of food for the decomposers, who make a certain amount of nutrients available to the plants. This energy cycle keeps the populations of all the different species in balance.
2. Suggest that a new animal has been brought here from another habitat. It eats the plants in the ecosystem, and, because the new animal has no natural predators here, its numbers increase and it significantly diminishes the plant life. While describing this drama, remove masses one-by-one from the plant corner of the cookie sheet until the sheet topples.
3. Explain that the four groups of organisms represented on the cookie sheet at the beginning of the demonstration are native to the region and that the newcomer is called a non-native species. Explain the concepts of native and non-native species as described in the lesson plan Background. Tell them that certain non-native species are invasive and have caused problems in water environments like the Chesapeake Bay and in other environments in Virginia and the United States.
4. Assign the following non-native species for students to research:

   - anthracnose fungus (*anthracnose*)
   - Asian longhorned beetle (*Anoplophora glabripennis*)
   - Asiatic clam (*Corbicula fluminea*)
   - Chestnut blight (*Cryphonectria parasitica*)
   - comb jelly (*Mnemiopsis leidyi*)
   - Eurasian water milfoil (*Myriophyllum spicatum*)
   - grass carp (*Ctenopharyngodon idella*)
   - green crab (*Carcinas maenas*)
   - gypsy moth (*Lymantria dispar*)
   - hydrilla (*Hydrilla verticillata*)
   - kudzu (*Pueraria montana* var. *lobata*)
   - mute swan (*Cygnus olar*)
   - nutria (*Myocastor coypus*)
   - phragmites (*Phragmites australis*)
   - purple loosestrife (*Lythrum salicaria*)
   - starlings (*Sturnus vulgaris*)
   - veined rapa whelk (*Rapana venosa*)
   - yellow iris (*Iris pseudacorus*)
   - zebra mussel (*Dreissena polymorpha*).

   (See "Using the Library Media Center for Project Research" and "Using the World Wide Web for Project Research" on pages 55–58 of the **Project Action Guide**.)

   Depending upon student reading level, you may assign all the organisms, giving one to each student, or you may choose to assign only some and have students research in pairs. If you do not assign all, be sure to include some land dwellers and some water dwellers, as well as some plants,

some animals, and at least one fungus. Use the reference materials listed in the Materials section, as well as non-fiction books and encyclopedias (also see Resources). The "Exotics in the Chesapeake" fact sheets (see Resources) contain specific information, and you might cut them apart to give to the students researching those organisms.

5. Direct students to conduct research on their assigned species and to take notes on the organism's characteristics such as
   - appearance, including as many details as possible
   - native habitat
   - problems resulting from its invasion
   - region where problems have occurred.

Session 2 (45 minutes)

Conduct this session in the classroom.

1. Inform students that they will produce "Wanted" posters detailing the characteristics of their non-native organism, using the results of their research from Session 1. The format of the poster should resemble the following example:

> Wanted: [name of organism],
> an invasive non-native [plant, animal, or fungus]
>
> [Students draw picture here.]
>
> Hometown: [native habitat]
> Last seen: [region where problems have occurred]
> For the crime of: [problems resulting from its invasion]

2. Direct students to organize themselves into two groups: (1) organisms that live in water, and (2) organisms that live on land. Direct students to further sort themselves into subgroups of animals, plants, and fungi.
3. Ask each student to tell for what crime his or her organism is wanted, or display the posters so that students can read all posters.
4. Discuss with students how humans may have played a role in introducing the organisms detailed on the "Wanted" posters. Discuss methods in use for controlling or eliminating the "wanted" organisms as well as laws enacted to prevent or control non-native invasive species.

Session 3 (45 minutes)

Begin this session in the schoolyard.

1. Provide students with clipboards (if available) and copies of the Non-native Plants in the Schoolyard lab sheet. Also provide gardening books and guidebooks for trees and wildflowers (see Resources).
2. Explain to students that while the organisms detailed on the students' posters cause significant problems to the ecosystems in which they are introduced, other non-native species cause problems that are not as obvious. Ask students whether they think the schoolyard has any non-native plants.
3. Discuss the question on the lab sheet: "How many of the plants in our schoolyard are native to Virginia, and how many are non-native?" Direct students to form their hypotheses, noting that the two percentages must add up to equal 100 percent. Follow the procedures detailed on the lab sheet.

Conclude the session in the classroom.

4. Have students share their results, calculate the percentages, and then discuss and write their conclusions. Help students understand that many plants used in landscaping come from geographic regions that receive more rainfall than our region; as a result, we waste more water caring for these plants than native plants. Many non-native plants also require pesticides because they are not adapted to deal with the insects of our region, and they may need extra fertilizer if they are native to regions with soil richer in nutrients. Both pesticides and fertilizers, of course, can have adverse affects on the water and the people and wildlife that depend upon the watershed.

Resources

Aquatic Nuisance Species Task Force. U.S. Fish and Wildlife Service. <http://www.ANSTaskForce.gov>.

Baskin, Yvonne. "The Growing Threat of Invasive Species." *Microsoft Encarta Encyclopedia 2001.*

Bell, C. Ritchie, and Anne H. Lindsey. *Fall Color Finder: A Pocket Guide to the More Colorful Trees of Eastern North America*. Chapel Hill: Laurel Hill Press, 1991. ISBN 0960868828.

Classroom Assessment Suggestions

- *"Wanted" poster includes a detailed physical description of the organism, correctly classifies it by Kingdom, and correctly identifies the problem it causes.*
- *Predicted percentages of native and non-native plants in schoolyard add up to 100 percent.*
- *Student uses guidebooks to identify plants correctly.*
- *Student contributes his or her own inferences about the effects of non-native plants on the watershed to class discussion.*

Better Homes and Gardens New Complete Guide to Landscaping. Des Moines: Merideth Books, 2002. ISBN 0696208504. (This gardening book includes pictures of common landscaping plants with their names.)

Burrell, C. Colston, ed. *Ferns: Wild Things Make a Comeback in the Garden*. Brooklyn: Brooklyn Botanic Garden, 1995. ISBN 0945352824.

Edlin, Herbert L. *The Tree Key: A Guide to Identification in Garden, Field, and Forest*. London: Frederick Wayne Publishers, 1979. ISBN 0723220352.

Invasive Alien Plant Species of Virginia. Virginia Dept. of Conservation and Recreation. <http://www.dcr.state.va.us/dnh/invinfo.htm>.

Invasive Species. Chesapeake Bay Program. <http://www.chesapeakebay.net/info/exotic.cfm>.

Miller, Dorcas S., and Ellen Amendolara. *Winter Weed Finder: A Guide to Dry Plants in Winter*. Rochester: Nature Study Guild, 1989. ISBN 0912550171.

Native Plants for Conservation, Restoration, and Landscaping. Virginia Dept. of Conservation and Recreation. <http://www.dcr.state.va.us/dnh/native.htm>.

Peterson, Roger Tory. *Roadside Wildflowers*. Peterson FlashGuides. Boston: Houghton Mifflin, 1997. ISBN 039582995X. (See <http://www.houghtonmifflinbooks.com/peterson/petersonhome.cfm>.)

Phillips, Roger. *Trees of North America and Europe: A Photographic Guide to More than 500 Trees*. 1978. New York: Random House, 1993. ISBN 0394735412.

"Rapa whelk research." *Molluscan Ecology Program.* Virginia Institue of Marine Science. <http://www.vims.edu/mollusc/research/merapven.htm>.

Robbins, Ken. *Autumn Leaves.* New York: Scholastic, 1998. ISBN 0590298798.

"Saga of the Gypsy Moth." *The Changing Forest: Forest Ecology.* Project Learning. Washington: American Forest Foundation, 1995. (See <http://www.plt.org/curriculum/forestecology.cfm>.)

Terlizzi, Dan, Jack Greer, and Paul Fofonoff. "Exotics in the Chesapeake: Introduction." Understanding Species Invasion Factsheet 1. Maryland Sea Grant, 1999. (See <http://www.mdsg.umd.edu/store/reports.html> for download.)

Terlizzi, Dan, Jack Greer, and Paul Fofonoff. "Exotics in the Chesapeake: Animals." Understanding Species Invasion Factsheet 2. Maryland Sea Grant, 1999. (See <http://www.mdsg.umd.edu/store/reports.html> for download.)

Terlizzi, Dan, Jack Greer, and Paul Fofonoff. "Exotics in the Chesapeake: Plants." Understanding Species Invasion Factsheet 3. Maryland Sea Grant, 1999. (See <http://www.mdsg.umd.edu/store/reports.html> for download.)

Turner, R. G., ed. *Botanica*. New York: Barnes and Noble Books, 1999. ISBN 0760716420.

"Using the Library Media Center for Project Research." Project Action Guide. *Lessons from the Bay*. 55–56.

"Using the World Wide Web for Project Research." Project Action Guide. *Lessons from the Bay*. 57–58.

Virginia. Dept. of Forestry. *Forest Trees of Virginia.* Illustrated fieldguide to trees in Virginia. <http://www.dof.state.va.us>.

Watts, May T. *Tree Finder: A Manual for the Identification of Trees by Their Leaves*. Rochester: Nature Study Guild, 1991. ISBN 0912550015.

Watts, May T., and Tom Watts. *Winter Tree Finder: For Identifying Deciduous Trees in Winter*. Rochester: Nature Study Guild, 1970. ISBN 0912550031.

Extensions for Students

- *Use the booklet, book, and Internet sites on native plants to choose native plants to plant in your schoolyard (see Resources).*
- *Research local, state, and federal laws regulating non-native plants. (See "Using the Library Media Center for Project Research" and "Using the World Wide Web for Project Research" on pages 55–58 of the* ***Project Action Guide****.)*
- *Search newspapers for news that relates to problems caused by invasive non-native species.*